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(पहला पुनरीक्षण)

Indian Standard

FRUIT AND VEGETABLE PRODUCTS — DETERMINATION OF SOLUBLE SOLIDS CONTENT — REFRACTOMETRIC METHOD

(First Revision)

ICS 67.080.01

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

October 2009 **Price Group 4**

Processed Fruits and Vegetable Products Sectional Committee, FAD 10

NATIONAL FOREWORD

This Indian Standard (First Revision) which is identical with ISO 2173 : 2003 'Fruit and vegetable products — Determination of soluble solids — Refractometric method' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Processed Fruits and Vegetable Products Sectional Committee and approval of the Food and Agriculture Division Council.

This standard was first published in 1993 based on the earlier version of the International Standard, namely, ISO 2173 : 1978 under dual numbering. The first revision of this standard is being brought about to align it with the latest edition of ISO 2173 : 2003 under dual numbering.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

FRUIT AND VEGETABLE PRODUCTS — DETERMINATION OF SOLUBLE SOLIDS CONTENT — REFRACTOMETRIC METHOD

(First Revision)

1 Scope

This International Standard specifies a refractometric method for the determination of the soluble solids in fruit and vegetable products.

This method is particularly applicable to thick products, to products containing suspended matter, and to products rich in sugar. If the products contain other dissolved substances, the results will be only approximate; nevertheless, for convenience the result obtained by this method can be considered conventionally as the soluble solids content.

NOTE For the determination of the soluble solids in fruit juices (not containing suspended matter) and in concentrated juices (clarified), the pyknometric method specified in ISO 2172 is applicable.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
soluble solids determined by the refractometric method
concentration of sucrose in an aqueous solution which has the same refractive index as the product analysed, under specified conditions of preparation and temperature

NOTE This concentration is expressed as a mass fraction in percent.

3 Principle

The refractive index of a test solution is measured at 20 °C ± 0,5 °C using a refractometer. The refractive index is correlated with the amount of soluble solids (expressed as sucrose concentration) using tables, or by direct reading on the refractometer of the mass fraction of soluble solids.

4 Reagents

Use only reagents of recognized analytical grade.

4.1 Water

The water used shall have been distilled twice in borosilicate glass apparatus, or shall be water of at least equivalent purity.

5 Apparatus

Usual laboratory apparatus and, in particular, the following.

5.1 Refractometer

Use one of the following.

5.1.1 Refractometer indicating the refractive index, by means of a scale graduated in 0,001, in order to allow readings to be estimated to 0,000 2.

This refractometer shall be adjusted so that at 20 °C ± 0,5 °C it registers a refractive index of 1,333 0 for distilled water.

5.1.2 Refractometer indicating the mass fraction of sucrose, by means of scale graduated in 0,10 %.

This refractometer shall be adjusted so that at 20 °C ± 0,5 °C it registers a mass fraction of soluble solids (sucrose) of zero for distilled water.

5.2 Means for circulating water, to maintain the temperature of the prisms of the refractometer (5.1.1 or 5.1.2) constant to within ± 0,5 °C, in the neighbourhood of 20 °C, which is the reference temperature (see 8.1).

5.3 Beaker, of capacity 250 ml.

6 Sampling

It is important that the laboratory receive a sample which is truly representative and has not been damaged or changed during transport or storage.

7 Procedure

7.1 Preparation of test solution

7.1.1 Clear liquid products

Thoroughly mix the laboratory sample and use it directly for the determination.

7.1.2 Semi-thick products (purees, etc.)

Thoroughly mix the laboratory sample. Press a part of the sample through a gauze folded in four, rejecting the first drops of the liquid and reserving the remainder of the liquid for the determination.

7.1.3 Thick products (jams, jellies, etc.)

Weigh into the tared beaker (5.3), to the nearest 0,01 g, a suitable quantity (up to 40 g) of the laboratory sample and add 100 ml to 150 ml of water. Heat the contents of the beaker to boiling and allow to boil gently for 2 min to 3 min, stirring with a glass rod. Cool the contents and mix thoroughly.

After 20 min, weigh to the nearest 0,01 g, then filter through a fluted filter or a Büchner funnel into a dry vessel. Reserve the filtrate for the determination.

7.1.4 Frozen products

After thawing the sample and removing, if necessary, stones, pips and hard seed-cavity walls, mix the product with the liquid formed during the thawing process and proceed as described in 7.1.2 or 7.1.3 as appropriate.

7.1.5 Dried products

Cut a part of the laboratory sample into small pieces. Remove, if necessary, stones, pips and hard seed-cavity walls, and mix carefully. Then weigh into a tared beaker, to the nearest 0,01 g, 10 g to 20 g of the sample. Add 5 to 10 times this mass of water and place on a boiling water bath for 30 min, stirring from time to time with a glass rod. If necessary, prolong the heating time until a homogeneous mixture is obtained. Cool the contents of the beaker and mix well.

After 20 min, weigh to the nearest 0,01 g, then filter into a dry vessel. Reserve the filtrate for the determination.

If the test solution is too dark to be read in the refractometer, dilute the test solution with concentrated sugar solution; never use water for this purpose. Mix weighed amounts of the solution under examination and a solution of pure sugar of about the same strength (see reference [1]).

7.2 Determination

Adjust the water circulation (5.2) in order to operate at the required temperature (between 15 °C and 25 °C) and allow it to flow to bring the prisms of the refractometer (5.1.1 or 5.1.2) to the same temperature, which shall remain constant to within ± 0,5 °C during the determination.

Bring the test solution (7.1) to the measuring temperature. Put a small quantity of test solution (2 or 3 drops are sufficient) onto the fixed prism of the refractometer (5.1.1 or 5.1.2) and immediately adjust the movable prism. Suitably illuminate the field of view. The use of a sodium vapour lamp allows more precise results to be obtained (especially in the case of coloured and dark products).

Bring the line dividing the light and dark parts of the surface into the field of view to the crossing of the threads. Read the value of the refractive index or the mass fraction of sucrose, according to the instrument used (5.1.1 or 5.1.2).

8 Expression of results

8.1 Corrections

8.1.1 If the determination has been carried out at a temperature other than 20 °C ± 0,5 °C, the following corrections are required.

a) For the scale indicating the refractive index (5.1.1), apply the formula:

$$n_D^{20} = n_D^t + 0{,}0013(t - 20)$$

where

n_D^{20} is the refractive index at 20 °C;

n_D^t is the refractive index at the temperature of measurement;

t is the temperature of measurement, in degrees Celsius.

b) For the scale indicating the mass fraction of sucrose (5.1.2), correct the result according to Table A.1.

8.1.2 If the determination has been carried out for the products with added salt, correct the refractometer reading, expressed as a concentration of sucrose at 20 °C ± 0,5 °C, for added salt by the following formula (see reference [2]):

$$S = (R - N) \times 1{,}016$$

where

S is the mass fraction of soluble solids, in percent, as sucrose, corrected for added NaCl;

R is the refractometer reading, as a mass fraction in percent, as sucrose;

N is the total chloride content, as a mass fraction in percent, expressed as NaCl;

1,016 is the correction factor for added salt.

8.1.3 If the determination has been carried out for the highly acidic products, such as citrus juices and concentrated citrus juices, correct the refractometer reading, expressed as a masss fraction of sucrose at 20 °C ± 0,5 °C, by making the following addition to the refractometric reading (see reference [3]):

$$0{,}012 + 0{,}193 \times M - 0{,}000\,4 \times M^2$$

where M is the total acidity expressed in grams per 100 g, at pH = 8,1, expressed as anhydrous citric acid (see reference [4]). The calculated values for this expression are given in Table A.2.

8.2 Calculation method

8.2.1 Refractometer with refractive index scale

8.2.1.1 Read from Table A.3 the mass fraction of soluble solids corresponding to the value read in accordance with 7.2, corrected if necessary in accordance with 8.1.1 a). In the case of liquid or semi-thick products (7.1.1 or 7.1.2), the mass fraction of soluble solids is equal to the number found. If the determination has been carried out on a diluted solution (7.1.3 or 7.1.5), the mass fraction of soluble solids, in percent, is equal to

$$\left(P \cdot m_1\right) / m_0$$

where

P is the mass fraction of soluble solids in the diluted solution, in percent;

m_0 is the mass, in grams, of the sample before dilution (7.1.3 or 7.1.5);

m_1 is the mass, in grams, of the sample after dilution (7.1.3 or 7.1.5).

8.2.1.2 If the determination has been carried out on a dark solution (see 7.1.5) that has to be diluted with concentrated sugar solution, the mass fraction of soluble solids, in percent, is equal to (see reference [1])

$$\frac{\left[\left(m_W + m_B\right) C - m_B D\right]}{m_W}$$

where

m_W is the mass, in grams, of the sample diluted with sugar solution;

m_B is the mass, in grams, of sugar solution used in the dilution;

C is the mass fraction of soluble solids, in percent, in the mixture ($m_W + m_B$), obtained from the refractive index;

D is the mass fraction of soluble solids, in percent, in the pure sugar solution, obtained from its refractive index.

Express the result to one decimal place.

8.2.2 Refractometer with sucrose scale

In the case of liquid or semi-thick products (7.1.1 or 7.1.2), the mass fraction of soluble solids, in percent, as sucrose, is equal to the value read in accordance with 8.1.1 b). If the determination has been carried out on a diluted solution (7.1.3 or 7.1.5), calculate the mass fraction of soluble solids by means of the formula given in 8.2.1.1, or the formula in 8.2.1.2 for a dark solution diluted with a sugar solution (see 7.1.5).

Express the result to one decimal place.

9 Repeatability

The absolute difference between two independent single test results, obtained using the same method on identical test material in the same laboratory by the same operator using the same equipment within a short interval of time, will in not more than 5 % of cases be greater than 0,5 g of soluble solids per 100 g or per 100 ml of product.

10 Test report

The test report shall specify:

- all information necessary for the complete identification of the sample;
- the sampling method used, if known;
- the test method used, with reference to this International Standard;
- all operating details not specified in this International Standard, or regarded as optional, together with details of any incidents which may have influenced the test result(s);
- the test result(s) obtained;
- if the repeatability has been checked, the final quoted result obtained.

Annex A
(normative)

Correction and convertion tables

Table A.1 — Correction of readings of the refractometer with scale indicating sucrose for a temperature different from 20 °C ± 0,5 °C

Temperature	**Scale reading for soluble solids,** % (by mass)									
°C	**5**	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**60**	**70**
	Corrections to be subtracted									
15	0,29	0,31	0,33	0,34	0,34	0,35	0,37	0,38	0,39	0,40
16	0,24	0,25	0,26	0,27	0,28	0,28	0,30	0,30	0,31	0,32
17	0,18	0,19	0,20	0,21	0,21	0,21	0,22	0,23	0,23	0,24
18	0,13	0,13	0,14	0,14	0,14	0,14	0,15	0,15	0,16	0,16
19	0,06	0,06	0,07	0,07	0,07	0,07	0,08	0,08	0,08	0,08
	Corrections to be added									
21	0,07	0,07	0,07	0,07	0,08	0,08	0,08	0,08	0,08	0,08
22	0,13	0,14	0,14	0,15	0,15	0,15	0,15	0,16	0,16	0,16
23	0,20	0,21	0,22	0,22	0,23	0,23	0,23	0,24	0,24	0,24
24	0,27	0,28	0,29	0,30	0,30	0,31	0,31	0,31	0,32	0,32
25	0,35	0,36	0,37	0,38	0,38	0,39	0,40	0,40	0,40	0,40

Table A.2 — Acid correction (for citrus juices and citrus juice concentrates)

Total acid pH = 8,1 expressed as anhydrous citric acid (g acid/100 g)	**Correction value** [a]	**Total acid pH = 8,1 expressed as anhydrous citric acid (g acid/100 g)**	**Correction value** [a]
0,2	0,04	4,2	0,81
0,4	0,08	4,4	0,85
0,6	0,12	4,6	0,89
0,8	0,16	4,8	0,93
1,0	0,20	5,0	0,97
1,2	0,24	5,2	1,01
1,4	0,28	5,4	1,04
1,6	0,32	5,6	1,07
1,8	0,36	5,8	1,11
2,0	0,39	6,0	1,15
2,2	0,43	6,2	1,19
2,4	0,47	6,4	1,23
2,6	0,51	6,6	1,27
2,8	0,55	6,8	1,30
3,0	0,58	7,0	1,34
3,2	0,62		
3,4	0,66		
3,6	0,70		
3,8	0,74		
4,0	0,78		

[a] The correction values given should be added to the refractometer readings with scale indicating sucrose obtained at 20 °C ± 0,5 °C

Table A.3 — Refractive index and corresponding mass fraction of soluble solids (sucrose)

Refractive index n_D^{20}	Soluble solids (sucrose) % (by mass)	Refractive index n_D^{20}	Soluble solids (sucrose) % (by mass)	Refractive index n_D^{20}	Soluble solids (sucrose) % (by mass)	Refractive index n_D^{20}	Soluble solids (sucrose) % (by mass)
1,333 0	0	1,367 2	22	1,407 6	44	1,455 8	66
1,334 4	1	1,368 9	23	1,409 6	45	1,458 2	67
1,335 9	2	1,370 6	24			1,460 6	68
1,337 3	3	1,372 3	25	1,411 7	46	1,463 0	69
1,338 8	4			1,413 7	47	1,465 4	70
1,340 3	5	1,374 0	26	1,415 8	48		
		1,375 8	27	1,417 9	49	1,467 9	71
1,341 8	6	1,377 5	28	1,420 1	50	1,470 3	72
1,343 3	7	1,379 3	29			1,472 8	73
1,344 8	8	1,381 1	30	1,422 2	51	1,475 3	74
1,346 3	9			1,424 3	52	1,477 8	75
1,347 8	10	1,382 9	31	1,426 5	53		
		1,384 7	32	1,428 6	54	1,480 3	76
1,349 4	11	1,386 5	33	1,430 8	55	1,482 9	77
1,350 9	12	1,388 3	34			1,485 4	78
1,352 5	13	1,390 2	35	1,433 0	56	1,488 0	79
1,354 1	14			1,435 2	57	1,490 6	80
1,355 7	15	1,392 0	36	1,437 4	58		
		1,393 9	37	1,439 7	59	1,493 3	81
1,357 3	16	1,395 8	38	1,441 9	60	1,495 9	82
1,358 9	17	1,397 8	39			1,498 5	83
1,360 5	18	1,399 7	40	1,444 2	61	1,501 2	84
1,362 2	19			1,446 5	62	1,503 9	85
1,363 8	20	1,401 6	41	1,448 8	63		
		1,403 6	42	1,451 1	64		
1,365 5	21	1,405 6	43	1,453 5	65		

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[1] AOAC Official Method 932.14, *Solids in sirups*. AOAC Official Methods of Analysis, 1995, 44.1.04

[2] AOAC Official Method 970.59, *Solids (Soluble) in Tomato Products: Refractive index method*. AOAC Official Methods of Analysis, 1995, 42.1.10

[3] EN 12143:1996, *Fruit and vegetable juices — Estimation of soluble solids content — Refractometric method*

[4] ISO 750:1998, *Fruit and vegetable products — Determination of titratable acidity*

[5] ISO 2172:1983, *Fruit juice — Determination of soluble solids content — Pycnometric method*

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices:			*Telephones*
Central	:	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	2323 7617 2323 3841
Eastern	:	1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
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